AkerSolutions

Design, Operation and Learning from the World's First Compression System Operating Subsea

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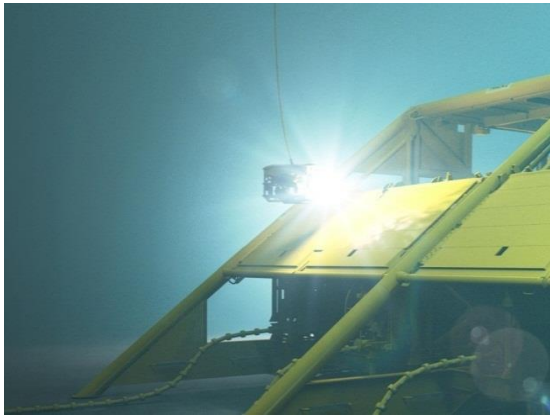
Aker Solutions creates solutions to unlock energy safely and sustainably for future generations

14,000
EMPLOYEES

20
COUNTRIES

46
LOCATIONS

175
YEARS OF EXPERIENCE

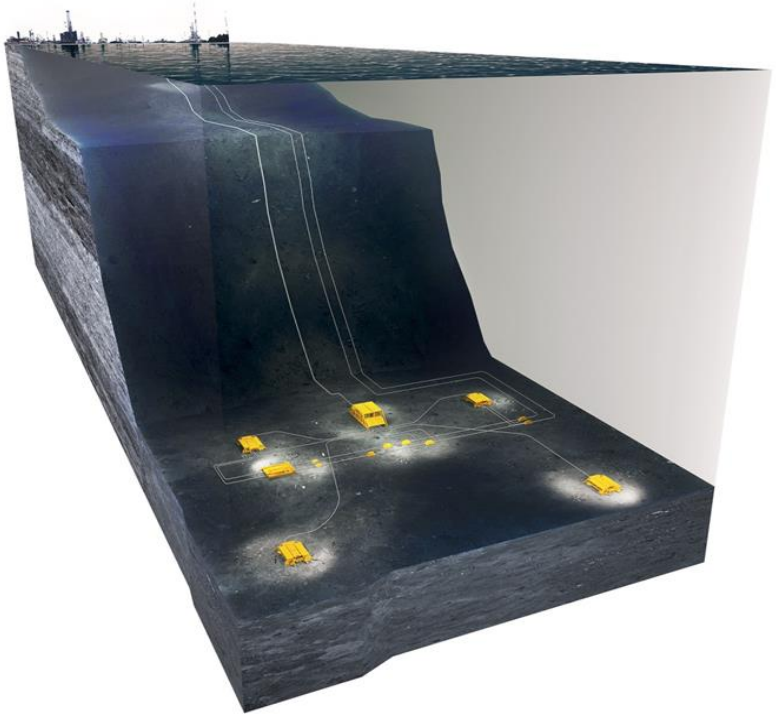


Introduction

Subsea gas compression – the benefits

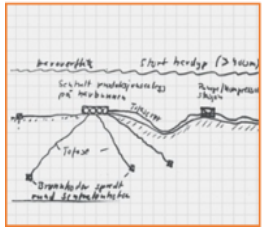
Relocating topside compression on the seabed, close to the reservoir, provides for a number of benefits:

- Reduces **CAPEX** and **OPEX**
- Provides for **increased total recovery**
- Enables for **accelerated production** and greater up-front return
- Enables **longer tie-back**
- Enables the use of **smaller pipeline**
- Replaces the need for topside manning
- Provides **flexibility** in flow assurance philosophies
- **Reduces carbon footprint**



Subsea gas compression – long term commitment

1985



1989-1993
Kværner Booster Station

2001-2003
Demo 2000 GasBooster™ Qualification

2004-2011
Ormen Lange Pilot Qualifications and EPC

2011-2013
Ormen Lange Compression Pilot

System Testing at Nyhamna

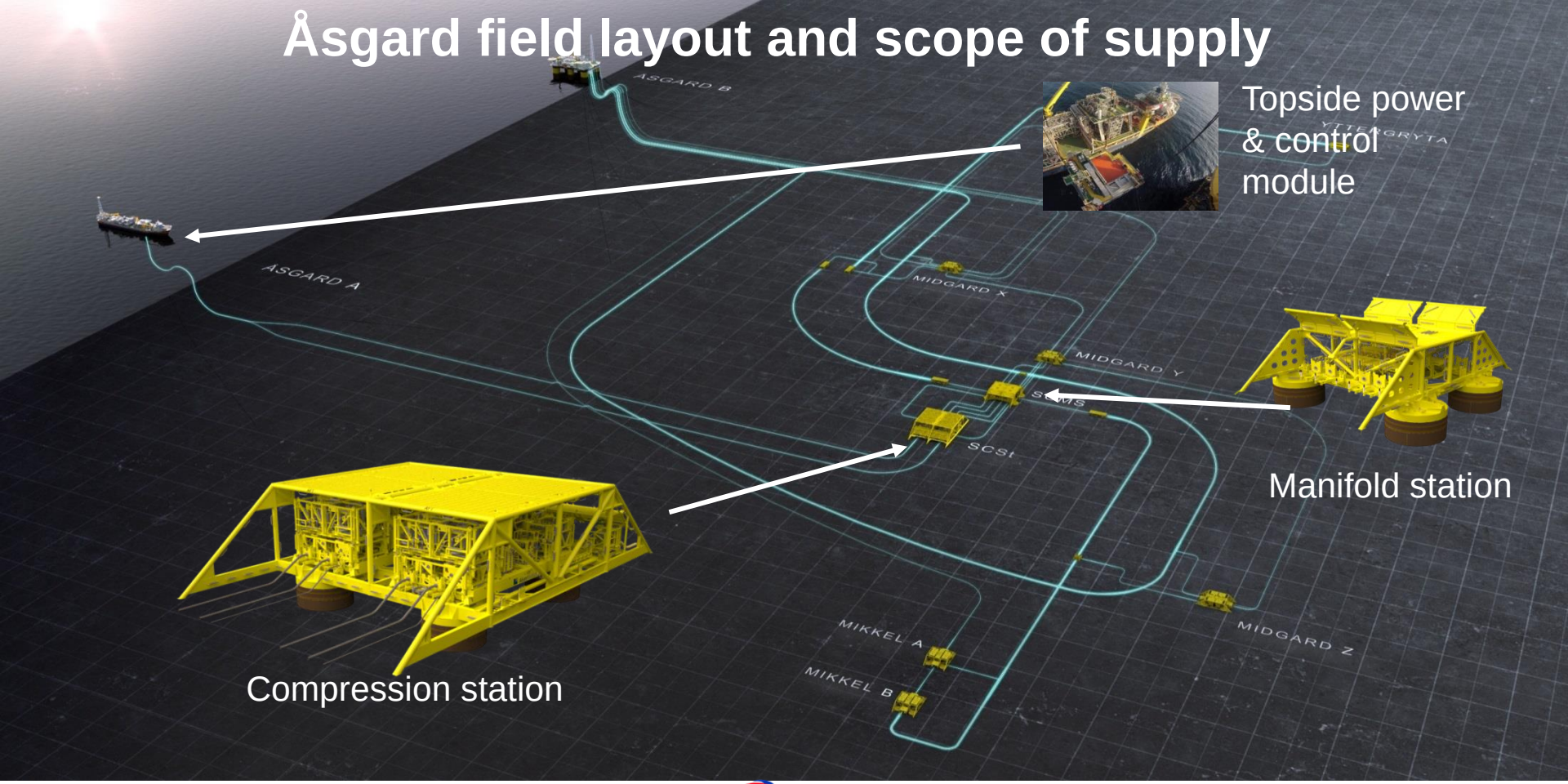
2010-2015
Åsgard Subsea Compression system EPC

2015 ->
Well Stream Compression (WSC)

Conventional Compression System


Åsgard subsea compression project

Åsgard field layout and scope of supply



Åsgard subsea compression – project details

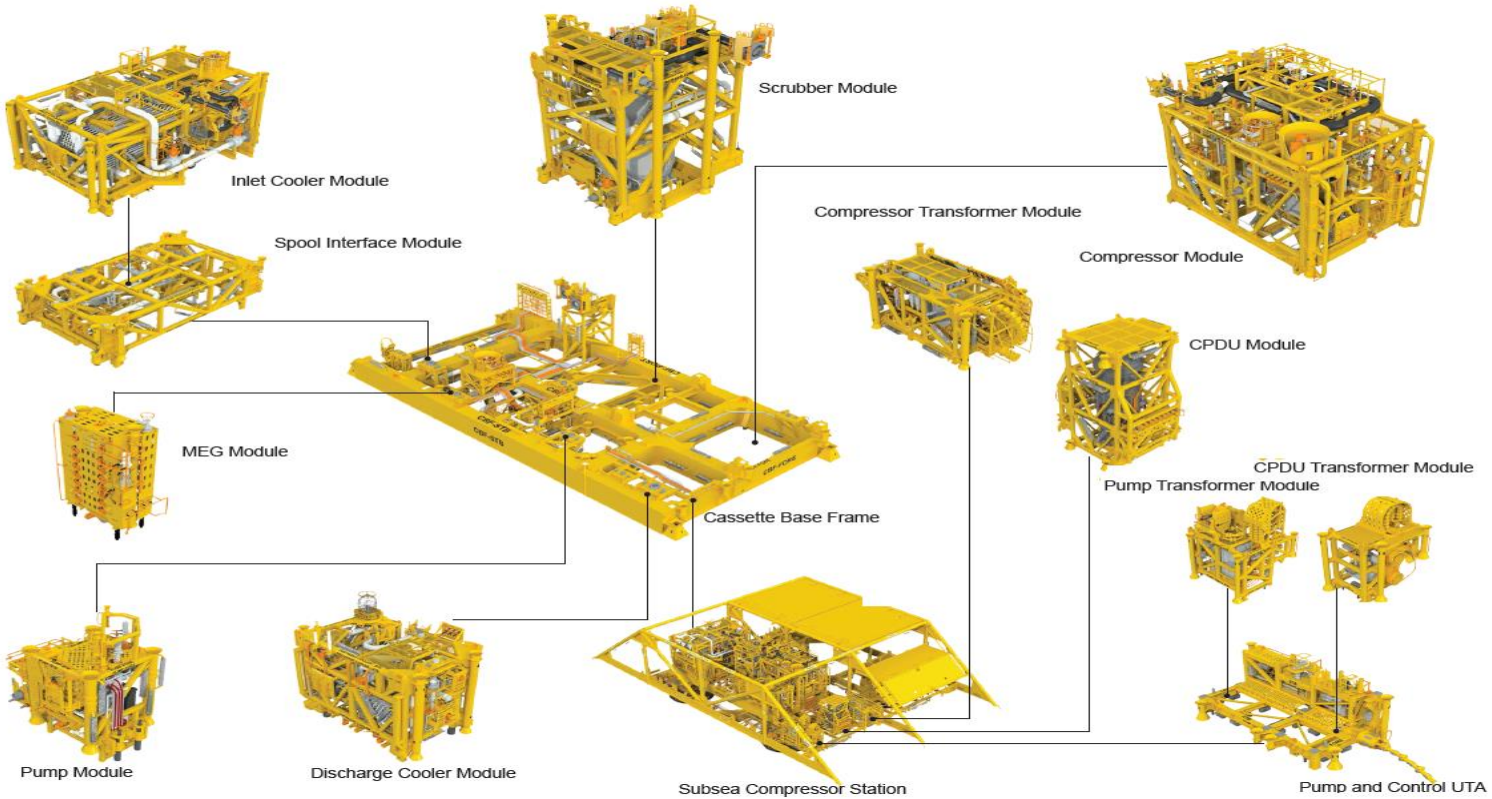
Project details

- Water depth: 260 m
- Tie-back distance: 40 km
- Flow rate: 21 MSm3/d
- Power: 2 x 11,5 MW
- Shut in pressure: 220 bar
- IOR: **306 million** barrels of oil equivalent

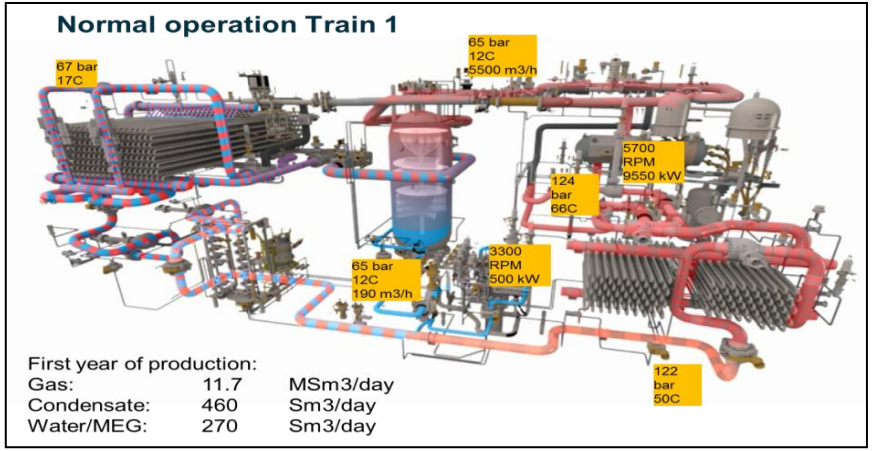
Project schedule

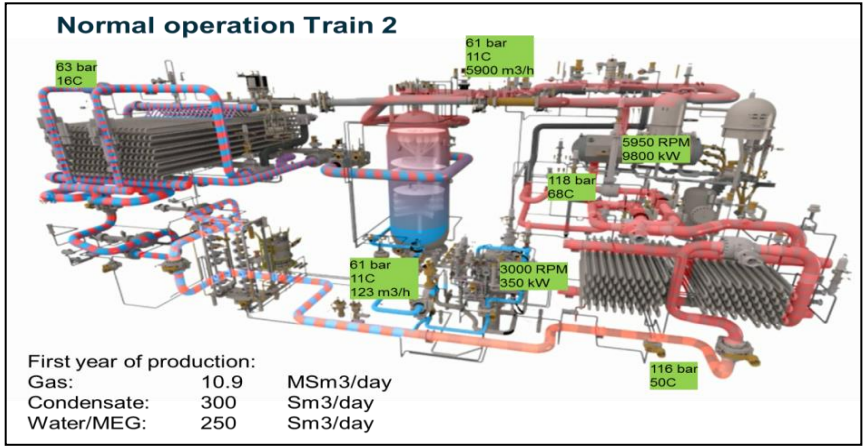
- 2006 - 2010: studies, Pre-FEED, FEED
- 2010: EPC contract (1st December)
- 2013: equipment and modules testing
- 2014: SIT and FUT
- 2015: delivery and start-up (16th of September)

Åsgard subsea compression system – subsea modules



Excellent operational performance





- Accumulated running hours to date: 12,000 (T1) + 8,800 (T2) = 20,800 in total
- Increased production during the first year of operation = 16 million barrels of oil equivalent
- Producing more condensate than expected
- Very low vibrations
- No trips / shutdown caused by the subsea compression system
- 100% availability for the subsea system

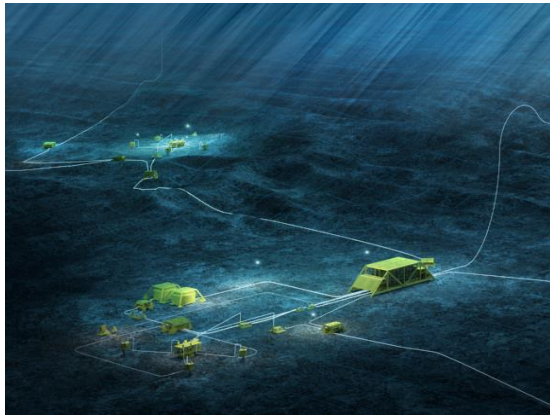
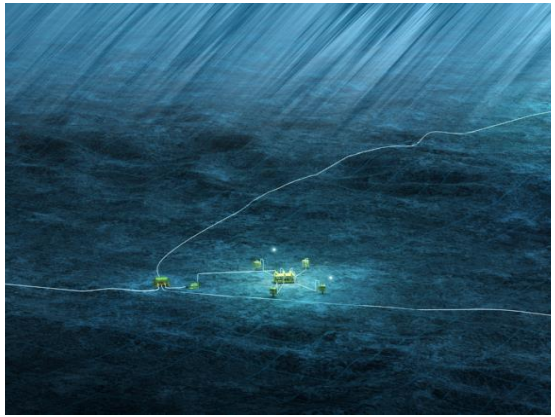
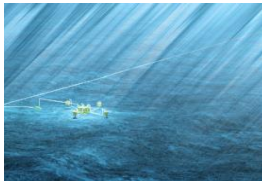
Lessons learnt

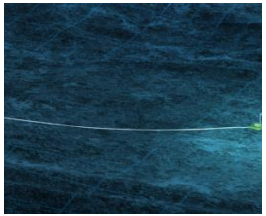
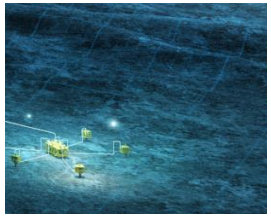
Lessons learnt

- Total system responsibility
  - Managing technology qualifications
  - Integrating core technologies in the system
  - Designing, manufacturing and testing
- Early cooperation with installation contractor
- Core team retention and development

Going forward

- Optimization by challenging requirements
- Rationalization of the capital spare parts
- Simplification of the testing philosophy

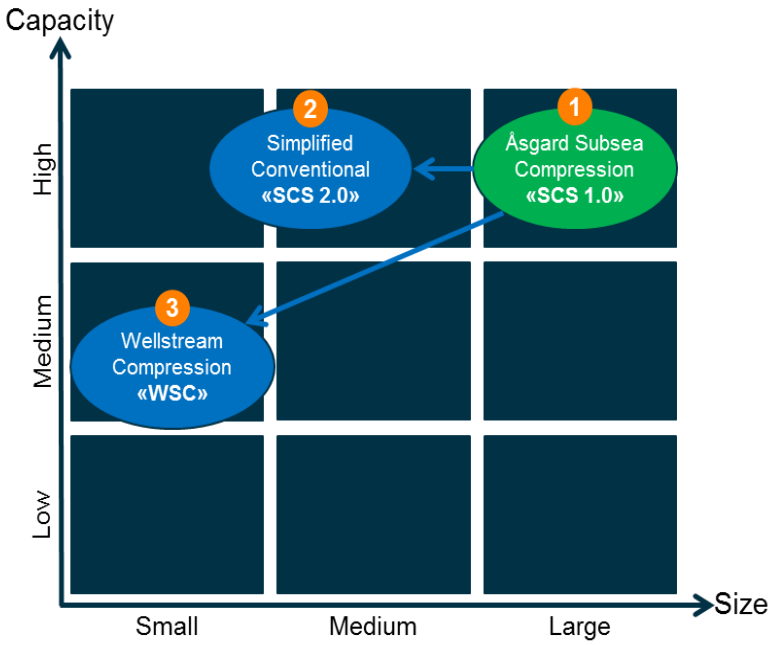




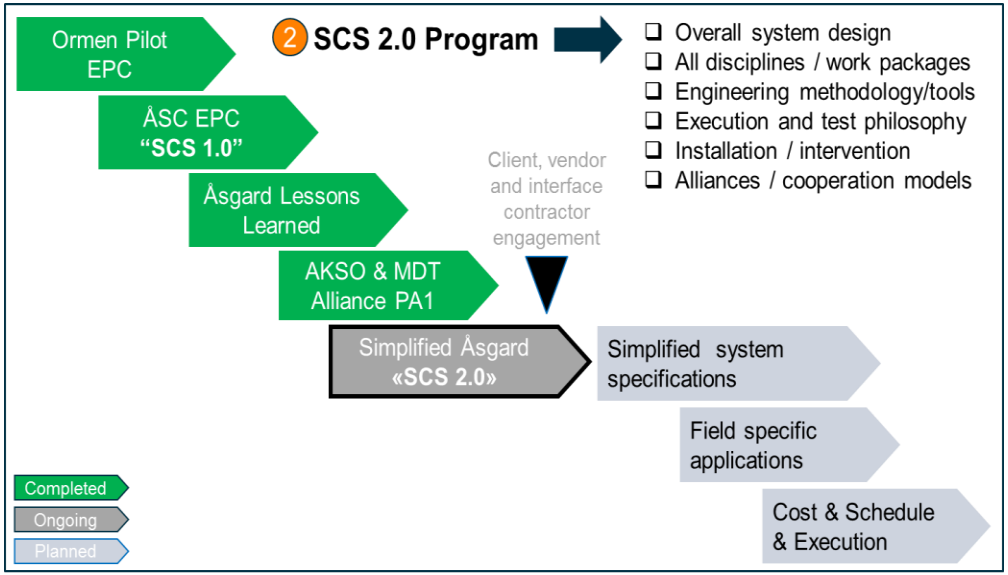



Next generation subsea compression systems

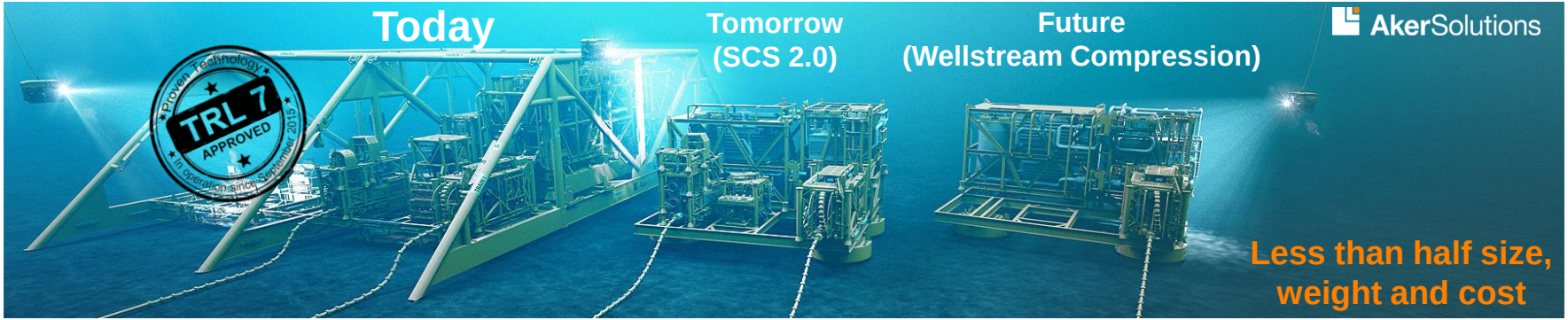
Next generation subsea compression systems

Reduce cost, size, weight, complexity and delivery time and remove need for heavy lift operations





Result – More than 50% reduction in size, weight and cost

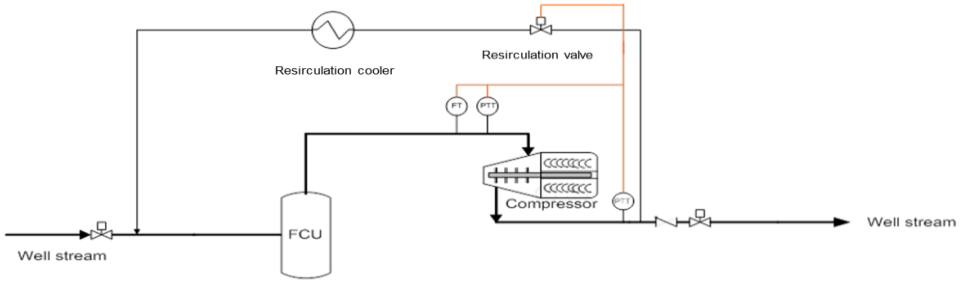


- Core functionality un-changed
- More than 50% reduction in size and weight and cost
- From 13 to 7 modules per train
- Simplified LV distribution using own SIS 2/DCFO compliant electrical actuators
- Simplified piping resulting in less pressure drop
- Optimized orientation of connection systems
- Single train fit inside 4-slot template
- No heavy lift, resulting in large installation savings

Subsea Well Stream Compression (WSC) system vision

- A robust, high capacity compression system that can handle wellstream conditions without scrubber and pump
- Design and operation philosophy
  - Liquid tolerant compressor handles normal liquid production
  - System design w/FCU handle upset conditions and transients

Control and automation
- Monitoring and control system designed to handle normal and upset conditions



Flow conditioning unit
- Smoothen GVF variations
- Slug accommodation
- Important to handle upsets

Compressor
- Handle continuous liquid load in wellstream
- Long term tested up to 30% LMF / 5% GVF
- Even distribution of flow at suction

Summary

Summary

- The subsea compression system installed at Åsgard is approaching 1.5 years of successful operation
- This is not only a technology leap, but it represents also a strong business case
- The learnings from the first project will allow to improve the next generation of subsea compression
- Australia could be one of the next offshore gas region to benefit from this technology.

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